An Announcement of

Highway Safety Literature

. . . A Bi-Monthly Abstract Journal

HSL No. 72-17 September 8, 1972 HS-011 409 - HS-011 468, HS-800 526; 662; 664; 666 - 668; 670; 673 - 674, HS-810 197; 216; 218 - 225, HS-820 187

HSL No. 72-17
September 8, 1972

SPECIAL ANNOUNCEMENT ON PAGE 21

THIS ISSUE CONTAINS:

HS-011 409 - HS-011 468
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U.S. Department of Transportation / National Highway Traffic Safety Administration

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An Announcement of
HIGHWAY SAFETY LITERATURE
. . . A Bi-Monthly Abstract Journal

Published twice-a-month by the National Highway Traffic Safety Administration,
Research Institute, Office of Accident Investigation and Data Analysis
Washington, D.C. 20590

INTRODUCTION

Publications such as journal articles, proceedings, and research reports announced in *Highway Safety Literature* include some of the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 72 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in locating citations by the HS-number, the cover bears the inclusive entry number for each issue.

Entries in *HSL* are arranged according to the NHTSA Subject Category List shown in the Table of Contents. The list is a two-level arrangement consisting of five major subject fields subdivided into 59 subject groups. Documents related directly to the National Highway Traffic Safety Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series). NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration. HS-800 000 series and HS-820 000 series are available for, purchase from NTIS or GPO (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array →	
NHSB Accession no	HS-800 218 Fld. 5/21; 5/9
Title of document	AN INVESTIGATION OF USED CAR SAFETY STANDARDS--SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L
Personal author(s)	by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams
Corporate author	Operations Research, Inc.
Collation →	
Publication date	1969 150p Contract FH-11-6921 Report no. ORI-TR-553-Vol-6; PB-190 523
Abstract	Appendices G-L to this study ot used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.
	Search terms; Wear; Trucks; Failures; Used cars; Inspection standards

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

AUTO THEFT–THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation .... Published in *FBI Law Enforcemen*
Bulletin v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the aut
theft problem and comments on anti
theft devices available now or in the
planning stage.

Search terms: Theft; Theft pro
tection; Stolen cars

(Note: If the date of a report o
Journal article is not given, the smal
letters nd will appear)

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NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brand names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval of any particular product, course, or equipment by the U.S. Department of Transportation, National Highway Traffic Safety Administration.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS AND INSTRUCTIONS FOR ORDERING

Articles and reports whose citations and abstracts appear in HSL are acquired from many sources, such as periodicals, journals, NHTSA Contractors' reports and NHTSA staff speeches, and other reports. Those reports other than NHTSA Contractors' reports and NHTSA generated reports and speeches (see introduction) are assigned a lower consecutive accession (HS-) number.

Department of Transportation personnel may borrow copies of publications announced in HSL from the NHTSA Technical Reference Division. Non-DOT Personnel, in the Washington, D.C. area, may borrow copies of publications for a 24-hour period only. Telephone (202) 426-2768. Government personnel in the Washington, D.C. area, use government ID phone 118-62768.

The names of the journals cited in HSL appear in *italic type* preceded by the words "Published in." The journal containing the article cited may be borrowed from most research and public libraries. Non-DOT personnel outside the Washington area should contact their company or agency libraries for assistance.

(Use any of the most recent *periodical directories* for location and price of publications cited in HSL)

NHTSA Contractors' reports and other reports can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that copies will be available for more than a limited period after a report is issued.

The more common availability sources are identified by symbols which are explained in the next column:

NTIS: National Technical Information Service, Springfield, Va. 22151. Order by accession number: HS, AD, or PB. Prepayment is required by NTIS coupon, check or money order (made payable to NTIS). GPO coupons are not acceptable. Documents are available in paper copy (PC); in full size original or reduced facsimile, and on microfiche (MF) a 4x6" negative sheet of film (reader required).

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration, General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874), Give HS-No.

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report numbers. Prices given are list; discounts are available to SAE members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders received without payment are subject to a $1 handling charge.

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WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS, add DOT/to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

1/0 ACCIDENTS

1/1 Emergency Services

HS-011 409 Fld. 1/1; 2/9

ANALYSIS OF DETECTION AND SERVICE SYSTEMS ON FREEWAYS

by Hartmut Keller

Published in *Accident Analysis and Prevention* v3 n3 p149-92 (Oct 1971)

23refs
Grant NSF-GK-1689

Doctoral dissertation, California Univ., Berkeley.

A response system to assist the stranded motorist is analyzed, and the effects of the system on the negative consequence of traffic incidents of controlled access highways is studied. The San Francisco-Oakland Bay Bridge serves as a model for a linear freeway. Variables used in the study include: emergency roadside telephones, mechanical service patrols, police patrols, call boxes, stationary police units, and stationary mechanical service units. It is concluded that the combination of using discrete communication terminals along a freeway, monitored at the mechanical service dispatch center, as the detection subsystem, and stationary police and mechanical units to render actual aid, can be operated with least cost and the greatest effectiveness.

Search terms: Freeways; Emergency road services; Computerized simulation; Benefit cost analysis; Queueing models; Systems analysis; Time factors; Simulation models; San Francisco; Oakland; Emergency reporting systems; Police traffic services; Disabled vehicles; Service needs; Traffic surveillance

1/2 Injuries

HS-011 410 Fld. 1/2; 5/20

SNOWMOBILING WITH ASSOCIATED MAXILLOFACIAL INJURIES

by Conrad I. Karleen

Minnesota Univ.

1972 5p 8refs
Report no. SAE-720258

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The charts of 392 patients who sustained snowmobile injuries from 1 Jan - 31 Dec 1969 and received treatment in five suburban hospitals outside Minneapolis were reviewed. Of the total 392 injured, 103 patients sustained maxillofacial (head and neck) injuries and accounted for 26% of all injuries. Improvement in the windshield construction to decrease the number of facial injuries is recommended.

Search terms: Snowmobile accidents; Injury case reports; Head injuries; Neck injuries; Facial injuries; Injuries by body area; Injuries by sex; Injuries by age; Fatality causes; Windshield caused injuries; Minneapolis; Time of day; Fatalities by age

AVAILABILITY: SAE

HS-011 411 Fld. 1/2; 5/4

INJURY RISK AS A FUNCTION OF AGE OF VEHICLES AND INJURY REDUCTION IN 1967, 1968 AND 1969 MODEL CARS

by H. C. Joksch

Published in *Accident Analysis and Prevention* v3 n3 p201-7 (Oct 1971)

5refs

Data from New Hampshire, North Carolina, and Virginia suggest that injury risk is a function of the age of cars (or other correlated factors), independent of model year before 1967, and that 1968 and 1969 model year cars have at least a 15%, possibly a 25% reduced injury risk. For the 1967 model year, data from North Carolina suggest a reduction in injury risk of about 10%.

Search terms: Vehicle age; Accidents by vehicle age; Injuries by vehicle age; Virginia; New Hampshire; North Carolina; Injury research

1/3 Investigation

HS-011 412 Fld. 1/3; 4/7

SKIDDING ACCIDENT SYSTEMS MODEL

by Kenneth D. Hankins; R. T. Gregory; William J. Berger

Texas A and M Univ. Texas Transp. Inst.

1971 30p
Report no. RR-135-1

Sponsored by Texas Hwy. Dept. in cooperation with Federal Highway Administration.

The theory introduced in this report is intended to identify the interdependence of factors influencing the skidding accident. The theory proposes that an analysis of accident variables can be made using a systems model. The selection and quantification of variables then enables corrective measures to be identified and evaluated. The greatest attention has been concentrated on the highway condition, with variables grouped into three areas: the highway section, the physical environment, and the meteorological environment.

Search terms: Wet skidding; Skidding accidents; Systems analysis; Accident factors; Variables; Environmental factors; Flow charts; Simulation models; Pavement skidding characteristics; Highway characteristics; Driver vehicle road interfaces; Mathematical models

1/3 Investigation (Cont'd.)

HS-011 413 Fld. 1/3; 4/7

PROGRESS IN THE CALCULATION OF VEHICLE COLLISIONS (FORTSCHRITTE IN DER BERECHNUNG VON FAHRZEUGZUSAMMEN-STO BEN)

by T. Marquard

Published in *ATZ-Automobil Technische Zeitschrift* v68 n3 p74-80 (Mar 1966)

10refs

Translation from German.

Methods of calculating impact in automobile collisions and their application in court trials are summarized. Covers: application of the laws of conservation of momentum and of angular momentum; degree of danger at intersections; roll-out after the collision; deformation and strain energy.

Search terms: Impact forces; Impact angle; Intersection collisions; Collision models; Equations of motion; Deformation; Mathematical analysis; Accident reconstruction; Vehicle trajectories; Kinetic energy; Accident scale drawings

1/5 Statistical data

HS-011 414 Fld. 1/5

MOTORIZATION AND TRAFFIC MORTALITY IN SWEDEN

by Bertil Aldman; Jan Thorson

Published in *Accident Analysis and Prevention* v3 n3 p215-21 (Oct 1971)

4refs

In Sweden the average annual number of motor vehicle deaths increased from 19 in 1911-1915 to 1266 in 1961-1965. At the end of this period the number of registered motor vehicles had reached 2,000,000. The increase in death rates was most pronounced for those 15-24 and 70-90 yrs. old. Female death rates seem to lag about 25 yrs. behind the male rates. The distribution of fatalities on road user categories is strongly age dependent. Fatalities of 15-yr-old moped drivers predominate. Death rates per 1,000 registered motor vehicles showed a decreasing trend for all age groups.

Search terms: Fatalities by age; Fatalities by sex; Fatality rates; Motorcycle operator fatalities; Pedestrian fatalities; Bicycle rider fatalities; Sweden; Mopeds

2/0 HIGHWAY SAFETY

2/2 Communications

HS-011 415 Fld. 2/2

STUDY OF RURAL, FREEWAY EMERGENCY COMMUNICATIONS FOR STRANDED MOTORISTS. FINAL REPORT

by Walter J. Roth

Michigan Dept. of State Highways

1971 101p 22 refs
Report no. TSD-TR-132-71; PB-204 047

A two-year experiment was conducted in Michigan with a motorist aid telephone system. The study was designed to determine the usefulness of the system to stranded motorists on a rural freeway and to observe and record the needs of motorists who stop. Surveys were made in summer and winter to determine what percentages of motorists used the phones, helped themselves, were aided by others, or walked, hitchhiked, or abandoned their vehicles. The use of the phones prevented motorists from being stranded for hours. Trucks were found to need more aid than their percentage in the traffic stream would indicate. A questionnaire evaluation by motorists showed 87% favored such a system as telephone call boxes. The system's cost appears to average about $22.00 per call. The use of the system is recommended.

Search terms: Roadside telephones; Emergency reporting systems; Driver aid systems; Disabled vehicles; Abandoned vehicles; Emergency road services; Service needs; Michigan; Rural highways; Freeways; Surveys; Questionnaires; Trucks; Waiting time; Statistical analysis; Summer; Winter

AVAILABILITY: NTIS as PB 204 047

HS-011 416 Fld. 2/2

AN AUTOMOTIVE TELEMETRY SYSTEM

by Ronald W. Ventola; Martin J. Moran; Karl W. Olson

Ohio State Univ.

1970 76p 5refs
Report no. EES-276A-11

Sponsored by Ohio Dept. of Highways and Bureau of Public Roads.

The design, development, and testing of a telemetry system for transmitting data from a moving test vehicle to a nearby ground site are described. The transmitting-receiving combination was designed to operate in the 240-260 MHz. band and to transmit or receive 21 channels of data simultaneously. The system was tested exhaustively. Data were transmitted from a moving vehicle to a fixed ground station and vice versa for distances ranging from 0.2-9 miles. Excellent results were obtained with the signals always being greater than 20 db as signals always being greater than 2 db as long as an unobstructed line of sight propagation path existed between the transmitter-receiver combination. It was concluded that the system is satisfactory in design and is ready for operational use.

Search terms: Highway communication; Telemetry; Radio communication; Radio interference; Channel capacities; Telecommunication; Topographical factors; Instrumented vehicles; Frequencies

2/4 Design and Construction

HS-011 417 Fld. 2/4

A STUDY OF PAVEMENT SKID RESISTANCE AT HIGH SPEEDS AND AT LOCATIONS SHOWN TO BE FOCAL POINTS OF ACCIDENTS. PHASE I REPORT (SKID TRAILER CONSTRUCTION)

by A. B. Moore; E. A. Whitehurst

Tennessee Univ.

1970 48p
Report no. Tennessee-Study-440, 929; PB-201 150

The construction of a two-wheel skid trailer capable of operation dependably at speeds of 75-80 mph is described. The design of the trailer hitch is unusual and worthy of note. The force measuring circuit is composed of two full bridge 120 ohm strain gage transducers, one for each wheel. Considerable difficulty was encountered in obtaining a suitable towing vehicle. The factory model was modified to provide the essential needs. Construction costs are included in the report, and engineering drawings of the trailer are contained in the appendix.

Search terms: Pavement skid resistance; Trailers; Fifth wheel devices; Skid resistance tests; Strain gauges; Transducers; Brake systems; Wetting; Tennessee; Towing; Costs; Engineering drawings

AVAILABILITY: NTIS as PB-201 150

HS-011 418 Fld. 2/4

RAILROAD-HIGHWAY SAFETY, PART 1: A COMPREHENSIVE STATEMENT OF THE PROBLEM. REPORT TO CONGRESS

Federal Railroad Administration; Federal Hwy. Administration

1971 137p 10refs

The grade crossing problem is described. The difficult questions of financial responsibility, divided jurisdiction, high cost of improvement, legal liability, and limited sources of funding have had a major impact on the ability to achieve new breakthroughs in solving the grade crossing problem. Aspects described include the driver's role, warning systems, visibility of trains, and pedestrian protection. Some statistics on grade crossing accidents are included.

Search terms: Railroad grade crossings; Railroad grade crossing accidents; Railroad grade crossing signals; Accident statistics; Vehicle train collisions; Driver error caused accidents; Legal responsibility; Accident location; Pedestrian safety; Warning systems; Vehicle visibility; Accident rates; Economic analysis; Safety device costs

HS-011 419 Fld. 2/4; 4/3; 4/7

AN ECONOMIC COMPARISON OF MOTORWAYS WITH TWO AND THREE LANES IN EACH DIRECTION

by J. C. Tanner

England. Road Research Lab.

1968 42p 14refs
Report no. RRL-LR-203

The object of this report is to study the factors that determine whether a new motorway should be built with two or three lanes in each direction, in a situation where the total budget for motorway construction is fixed. Empirical data on construction costs, speed-flow relations, and operating costs are presented, and these data are used in calculations based on an idealised mathematical model of a motorway network. It is concluded that it is better to provide three lanes each way if, but only if, two lanes each way would be running at or near their absolute capacity within 10 to 15 years of construction.

Search terms: Highway construction; Highway costs; Highway design; Mathematical models; Great Britain; Trip frequencies; Trip length; Four lane highways; Six lane highways; Economic analysis; Traffic capacity; Traffic models; Speed volume relationships; Vehicle operating costs

HS-011 420 Fld. 2/4

SLIPPERINESS OF HIGHWAY PAVEMENTS. PHASE I. FINAL REPORT.

by David C. Mahone; Stephen N. Runkle

Virginia Hwy. Res. Council

1971 67p 10refs
Report no. VHRC-70-R47; PB-203 700

To gain knowledge of the wet friction levels needed for various traffic conditions, this study evaluated the relationships between accumulated traffic volumes and pavement friction and between wet weather accidents and pavement friction. In addition the study evaluated speed gradients and machine correlations. Speed gradients were not found to be different for any of the paving mixes normally used in Virginia, and the average gradient was about 0.7. Stopping distance tests were also performed so that a correlation could be established between the values obtained with the trailer and those obtained with the stopping distance car. Regression analyses on these data indicate that the best predicting equations for stopping distance numbers occur when the trailer tests at 30 mph. The relationships between accumulated traffic volumes and friction levels are described. Four categories of roads were also studied in connection with wet road accidents and

2/4 Design and Construction (Cont'd.)

HS-011 420 (Cont'd.)

the minimum predicted car skid number found to be 42 at traffic speeds of 65-70 mph.

Search terms: Pavement skidding characteristics; Wet skidding; Traffic volume; Friction studies; Wet road conditions; Speed patterns; Stopping distance; Skidding accidents; High speed; Regression analysis; Road grades; Pavement tests; Pavement skid resistance; Pavement wear; Road materials; Mathematical models; Virginia

AVAILABILITY: NTIS as PB-203 700

2/9 Traffic Control

HS-011 421 Fld. 2/9; 4/7

A GENERAL TRAFFIC FLOW SIMULATION MODEL FOR FREEWAY OPERATION

by Stewart Leland; F. E. Coleman

Connecticut Dept. of Transp.

Published in HS-011 440, *Committee on Computer Technology, American Association of State Highway Officials National Conference Proceedings,* 1971 p9-66

Presented at the annual national conference of the American Assoc. of State Highway Officials' Committee on Computer Technology, Albany, 27-28 May 1970.

The objective of the Connecticut simulation model is to simulate vehicle flow on freeway-type facilities, including elements of design and operation that affect vehicle flow and capacity. The modelling concepts and computer program logic are presented. A case to corroborate the model validation is included. It is demonstrated that the model can, within acceptable statistical limits, duplicate the important stream characteristics that indicate the level of service and operational characteristics of a geometric design. It is shown further that the model can be calibrated to an area to reflect general driver ability or aggressiveness. It is concluded that the model logic is sound and can be expected to perform adequately in the analysis of any geometric designs.

Search terms: Traffic simulation; Traffic models; Freeway driving; Connecticut; Driver performance; Validation; Speed; Headways; Field tests

HS-011 422 Fld. 2/9; 3/4

WRONG WAY 4–HIGHWAY REFLECTORS

by H. W. Case; S. F. Hulbert; Jinx Beers

California Univ. ITTE

1971 25p. 6refs
Report no. UCLA-Eng-7118; PB-204 081

In order to alert drivers who actually reach a freeway going in the wrong direction, California uses reflectors between the freeway lanes which show white to drivers going the right way and shine red to the wrong way driver. Eleven different configurations of red highway reflectors were presented in 16mm animated films in the UCLA Driving Simulation Laboratory. Drivers' verbal responses and involuntary decelerations showed an urgent need to inform the public of the existence of the red reflectors and their intended meaning. The tests also showed that the regular pattern of reflectors now being used is the least effective to uninformed drivers and that an irregular configuration which is not continuously repeated elicits the most responses from uninformed drivers.

Search terms: California; Wrong way driving; Freeway driving; Reflectors; Reflectorized pavement markings; Color coding; Driving simulation; Pattern recognition

AVAILABILITY: NTIS as PB-204 081

HS-011 423 Fld. 2/9

A SYSTEM FOR MEASURING AND MARKING NO-PASSING ZONE LIMITS. FINAL REPORT

by C. P. Bastuscheck

HRB-Singer, Inc.

1971 31p

Final report on PDH Agreement no. 42991.

A system for determining the proper pass/no pass zones on two-lane rural highways is described. The system consists of two pickup trucks equipped with a sight distance measuring device, an operator console, paint code computer, and paint spray equipment. A radio distance measuring system is mounted in the two trucks to monitor the spacing between the trucks as they travel (15-25 mph) along a highway to be marked. The output of the measuring system provides information to the operator of the second truck to maintain the spacing at the selected minimum safe passing sight distance. A flashing light mounted on the leading truck is the target for determining when the truck is not in sight. A second operator in the trailing truck causes marks to be painted on the pavement when the leading vehicle disappears from view, and again when it reappears. These marks are used later by the paint truck crews to mark the appropriate stripes on the road surface.

Search terms: Passing zone markings; Passing zones; No passing zones; Two lane roads; Rural roads; Sight distances; Pickup trucks; Vehicle spacing; Passing; Pavement markings; Radio communication; Flashing lamps

HS-011 424 Fld. 2/9; 3/4; 4/5

DEVELOPMENT OF INFORMATION REQUIREMENTS AND TRANSMISSION TECHNIQUES FOR HIGHWAY USERS

by G. F. King; H. Lunenfeld

Airborne Instruments Lab.

1971 251p refs
Report no. NCHRP-123

The information needs of drivers were studied, particularly in reference to traffic signs. All pertinent factors and functions of the information system were defined and measured. The research included parameters which motivate the driver to respond naturally and safely to the range of messages transmitted and attempted to identify the capacity of drivers to assimilate varying amounts of information. It was found that a demanding priority exists in satisfying information needs relating to the basic tasks of tracking and speed control which have priority over needs relating to driver response to road and traffic situations. Information needs relating to direction finding and trip planning rank lowest in this hierarchy. Satisfying the primacy of information needs is basic to the design of a highway information system. Expectancy is another key factor in the driving task. A procedure is included for applying human factor principles to the review of information system designs. Night legibility of signs is also considered.

Search terms: Information theory; Information system design; Data transmission; Driving task analysis; Perceptual loads; Complexity; Loading (operator performance); Driver behavior research; Sign legibility; Sign effectiveness; Sign design; Computerized simulation; Computer programs; Traffic signs; Highway signs; Night visibility; Driver vehicle road interfaces; Driver performance; Systems analysis; Flow charts; Sign visibility; Sign reflectance; Sign location; Mathematical models

AVAILABILITY: HRB $9.60

3/0 HUMAN FACTORS

3/1 Alcohol

HS-011 425 Fld. 3/1; 3/11; 1/5

ALCOHOL AND PEDESTRIAN FATALITIES: A STUDY OF FATAL PEDESTRIAN COLLISIONS IN SAN DIEGO COUNTY

by William E. Marsden, Jr.

San Diego County Engineer Dept.

1972 52p 14refs

Fifty fatal pedestrian-vehicle collisions involving pedestrians known to have been drinking were studied, representing about 20% of the fatal pedestrian accidents in San Diego during the study period. The time, date, location, age, sex, and blood alcohol levels of all cases are presented. Of the 44 available police investigation reports, information was noted concerning weather conditions, lighting, locality, road conditions, violations, and events leading to the collision. It was concluded that more research is needed on drinking pedestrians; that at least 25% of fatal pedestrian accidents involve drinking pedestrians; that 66% of the fatally injured drinking pedestrians had drinking problems, as suggested by blood alcohol levels in excess of 0.15%; and that streets adjacent to drinking establishments do not necessarily generate large numbers of pedestrian fatalities. Some cases were suicides.

Search terms: Pedestrian fatalities; Pedestrian accidents; Accident studies; San Diego; Time of accidents; Accident location; Pedestrian age; Pedestrian sex; Pedestrian characteristics; Pedestrian intoxication; Drinking pedestrians; Suicide by vehicle; Accident statistics; Alcoholism; Accident case reports; Police reports; Environmental factors; Accident factors; Light conditions; Traffic law violations; Blood alcohol levels; Weather; Precrash phase; Road conditions; Time of day

HS-011 426 Fld. 3/1

THE PHYSTESTER: A TEST FOR DRIVER IMPAIRMENT

by J. A. Tennant

General Motors Corp.

[1972] 17p 7refs

A history of the concept and development of the Phystester is presented. The relative merits of breath alcohol concentration and behavioral tasks performance measurements as methods of identifying intoxicated drivers are discussed. The psychomotor test presented by the Phystester, its relationship to the higher mental functions that are degraded by alcohol, and its optimization are also discussed. The test consists of two tasks: entering a multi-digit number which is displayed at the onset of the test, onto a keyboard; and interrupting the keyboard sequence of the first task to respond to a displayed light appearing at a random time within the allowed total response time. The test is intended to exercise the faculties that are considered dominant in driving.

Search terms: Phystester; Blood alcohol levels; Alcohol detection and interlock systems; Drinking drivers; Driver intoxication; Driver reaction time; Driver physiological test devices

HS-011 427 Fld. 3/1

ALCOHOL AND THE DRIVING TASK. DRIVER AND TRAFFIC SAFETY EDUCATION RESEARCH DIGEST

by Harry L. McDonald

Highway Users Federation for Safety and Mobility

1971 16p 13refs

Produced with assistance of the Automotive Safety Foundation.

3/1 Alcohol (Cont'd.)

HS-011 427 (Cont'd.)

A review is presented of research on the effects of alcohol on driving, such as increase in risk taking, late and exaggerated responses, increases in accidents, and in their severity, cost, and the number of fatalities. An alcohol countermeasures program, including the establishment in 1970 of an Office of Alcohol Countermeasures and federally-funded community demonstration projects called Alcohol Safety Action Programs are described. Improvements in alcohol education programs, especially for beginning drivers, are recommended.

> Search terms: Alcohol education; Alcohol effects; Alcoholism; Drinking drivers; Driver intoxication; Driver reaction time; Alcohol Safety Action Projects; Alcohol usage deterrents; Blood alcohol levels; Accident factors; Problem drivers

HS-011 428 Fld. 3/1

THE USE OF SMALL GAS CHROMATOGRAPHS FOR BREATH TESTING OF DRUNKEN DRIVERS BY THE HIGHWAY PATROL UTILIZING THE PUBLIC HEALTH LABORATORY (KANSAS)

by Blaine L. Glendening; Allen C. Rush; Nicholas D. Duffett

Published in *Health Laboratory Science* v8 n3 p131-41 (Jul 1971)

15refs

> Presented at the 98th annual meeting of the American Public Health Assoc., Houston, 28 Oct 1970.

A convenient, accurate, and specific test for alcohol in the breath of suspected drunken drivers is now available through the use of the gas chromatograph. One of these, known as the Alco-Analyzer, has been critically studied by the Kansas State Department of Health. Operating parameters have been established and the methods have been proved to give satisfactory results when operated by trained personnel of the Highway Patrol. While the primary function of the instrumentation is to analyze breath by both direct testing and after collection in specially prepared tubes, it has also been demonstrated that blood can be accurately analyzed by the head-space method. Procedures are convenient, give accurate results and are specific for ethyl alcohol.

> Search terms: Kansas; Alcohol breath tests; Gas chromatography; Test equipment; Alcohol blood tests; Alcoanalyzer; Drinking drivers

HS-011 429 Fld. 3/1

CHROMATOGRAPHIC BREATH ALCOHOL TEST PROGRAM IN IOWA

by Robert L. Morris; Wallace Van Note; W. J. Hausler, Jr.

Published in *Health Laboratory Science* v8 n3 p142-9 (Jul 1971)

6refs

> Presented at the 98th annual meeting of the American Public Health Assoc., Houston, 28 Oct 1970.

A program of breath alcohol testing using indium tube encapsulation of 0.25ml deep alveolor air specimens for subsequent chromatographic evaluation is described. Data showing shelf life of encapsulated breath specimens, chromatographic precision, and accuracy and correlation between breath alcohol and blood alcohol content are presented. A presumptive test for alcohol involvement is discussed. Cost estimates for collection and analytical devices are included along with information on distribution of blood alcohol content of arrested suspects in Iowa.

> Search terms: Iowa; Alcohol breath tests; Blood alcohol levels; Test equipment; Chromatography; Legal factors; Costs

HS-011 430 Fld. 3/1

COLORADO BREATH ALCOHOL PROGRAM

by David McGuire; J. Robert Zettl

Published in *Health Laboratory Science* v8 n3 p150-4 (Jul 1971)

1ref

> Presented at the 98th annual meeting of the American Public Health Assoc., Houston, 28 Oct 1970.

The Colorado program for blood alcohol determination by a gas chromatographic breath test is described. Data are presented on the precision and accuracy of the instruments based on field trials with State Patrol officers operating the machines. The machine has a capability of making delayed tests from field collected breath specimens.

> Search terms: Colorado; Alcohol breath tests; Reliability; Gas chromatography

3/4 Driver Behavior

HS-011 431 Fld. 3/4

SIMULATOR STUDIES OF THE DRIVER'S DYNAMIC RESPONSE IN STEERING CONTROL TASKS

by David H. Weir; Charles K. Wojcik

Published in *Highway Research Record* n364 p1-15 (1971)

9refs

> Sponsored by Committee on Simulation of Driving Task and presented to HRB 50th Annual Meeting. Includes discussion and author's closure.

The UCLA driving simulator featuring moving model landscape and TV projected roadway image was used in series of tests involving driver steering control to regulate the car during random-appearing crosswind gusts and to maintain the car in the center of the lane on a tangent roadway. The dynamic response properties of five driver subjects were measured as quasi-linear describing functions. The data show fairly consistent values of driver time delay and control response bandwidth across subjects and good repeatability within subjects on successive runs. The data are consistent with previously published models for driver steering control, and they provide some insight into the perceptual feedback structure that the driver may be using.

Search terms: Driving tasks; Driving simulators; Driving simulation; Overtaking; Passing; Crosswind; Driver behavior; Driver performance; Vehicle dynamics; Driver reaction time; Driver characteristics

HS-011 432 Fld. 3/4; 4/5

PREVIEW-PREDICTOR MODEL OF DRIVER BEHAVIOR IN EMERGENCY SITUATIONS

by C. V. Kroll

Published in *Highway Research Record* n364 p16-26 (1971)

6refs

Sponsored by Committee on Simulation of Driving Task and presented at the HRB 50th annual meeting.

A research task directed toward development of a modified version of the Bureau of Public Roads/Cornell Aeronautical Lab. computer simulation of automobile dynamics is summarized. In particular, a nonlinear model of driver behavior has been formulated and incorporated into a "noncollision" version of the vehicle simulation. The nonlinear formulations have been aimed at producing a closed-loop control mechanism suitable for use in the investigation of driver behavior in emergency and precollision situations, specifically those situations involving maneuvers at or near the limits of vehicle and driver control. The developed model is described, and its responses are discussed.

Search terms: Precrash phase; Driver emergency responses; Computerized simulation; Vehicle dynamics; Driver performance; Driver behavior; Driving task models; Tracking; Speed control; Steering

HS-011 433 Fld. 3/4

USE OF SIMULATION IN A STUDY INVESTIGATING ALERTNESS DURING LONG-DISTANCE, LOW-EVENT DRIVING

by E. Donald Sussman; Robert C. Sugarman; James R. Knight

Published in *Highway Research Record* n364 p27-32 (1971)

1ref

Presented at the HRB 50th Annual Meeting.

The effects of task complexity, acoustic noise level, and duration of trip on measures of alertness are studied, using the Cornell Aeronautical Laboratory driving simulator. Analysis of the results showed: the driver's ability to maintain his vehicle on the road under low-event conditions and the rate of steering wheel corrections made by the driver both decrease linearly with time over four hours; there is significant negative correlation between position error and steering wheel correction; the driver is less likely to be able to control his vehicle accurately during an emergency after four hours of driving than after one, and this effect is most severe after exposure to a high level of acoustic noise; analysis of occipital EEG recordings reveals an overall increase in the frequency of occurrences of alpha bursts for all subjects.

Search terms: Driving simulation; Driver behavior research; Driving task analysis; Travel time; Noise exposure; Driver performance; Driver fatigue; Driver emergency responses; Driving conditions; Electroencephalography; Time factors

HS-011 434 Fld. 3/4

A SHORT COURSE IN EMERGENCY DRIVING—DO-IT-YOURSELF STYLE

by Kenneth F. Licht

Published in *Traffic Safety* v72 n2 p12-3, 37-8 (Feb 1972)

A safety educator describes his personal principles of accident avoidance and collision cushioning, which were worked out by trail and error. Principles are: don't depend on brakes to prevent a collision; if you can't stop, steer; if you can't steer, skid; if you must collide, choose your cushion; do everything possible to avoid collision, but if collision is inevitable minimize the consequences.

Search terms: Driver emergency responses; Driver performance under stress; Braking; Steering; Skidding; Accident avoidance; Crash cushions; Stopping distance; Impact attenuation

3/6 Driver Licensing

HS-011 435 Fld. 3/6; 4/1

OCCUPATIONAL LICENSES. AUTHORITY FOR AND CONTROL OF RESTRICTED DRIVING FOR EMPLOYMENT PURPOSES. A SURVEY OF STATE LAWS AND THEIR ADMINISTRATION.

by Anthony Antony

Highway Users Federation

1971 45p

3/6 Driver Licensing (Cont'd.)

HS-011 435 (Cont'd.)

This document provides information on "occupational" licenses which are issued for employment purposes to persons who would normally be subject to license suspension or revocation due to their driving records. Most expressed views oppose the issuance of such licenses on the grounds that they defeat the purposes of effective driver control and are difficult or impossible to police. Some feel that in hardship cases judges should have the option to allow such licenses rather than mandatory revocation. At present 23 states permit the issuance of "occupational" licenses. This survey summarizes the comparative status of these laws to show consistencies and differences.

Search terms: Driver license restrictions; Driver license laws; Driver license revocation; Driver license suspension; Problem drivers; State laws; Law uniformity

HS-011 436 Fld. 3/6

THE ELDERLY DRIVER: IS THERE A PROBLEM?

by Keith E. Jolles

Published in *Autocar* v135 n3952 p24-5 (30 Dec 1971)

The problems, advisability, and implications of requiring a medical examination to certify fitness or unfitness to drive of all drivers over 65 are explored. It is felt that elderly drivers do not constitute an abnormally high risk group but that some form of examination is advisable to detect physical functions no longer adequate for safe driving.

Search terms: Aged drivers; Driver physical fitness; Driver physical examinations

3/8 Environmental Effects

HS-011 437 Fld. 3/8

SOUND INSULATION OF GLAZING WITH RESPECT TO TRAFFIC NOISE

by P. A. De Lange

Published in *Applied Acoustics* v2 n3 p215-36 (1969)

7refs

The marked increase of road traffic in many counties has brought about a traffic noise problem. From the viewpoint of building acoustics the problem is one of studying how outer walls and sometimes roofs as well perform as sound barriers. It is well known that sound insulation is rather small; this is largely due to sound leaks, which provide so-called natural ventilation of the building. A series of sound insulation measurements in the laboratory on some 30 types of glazing and a study of the means of arranging all data obtained in such a way that the best type of glazing system can be chosen are described. Typical and representative results of the measurements and the system for determination of actual noise conditions in buildings due to traffic noise are described.

Search terms: Traffic noise; Acoustic measurement; Noise standards; Noise tolerances; Noise exposure; Laboratory tests; Insulation; Glazing materials; Acoustics; Materials tests; Mathematical analysis; Glass tests; Frequencies; Mathematical models

3/9 Impaired Drivers

HS-011 438 Fld. 3/9; 3/6

EPILEPSY AND DRIVING

by R. D. H. Maxwell; G. E. Leyshon

Published in *British Medical Journal* v3 p12-5 (3 Jul 1971)

13refs

Studies of a series of patients show that many and probably most epileptics have obtained driving licenses by concealment of their condition, yet new regulations continue to expect true declarations. It is suggested that, in common with applicants for a public service vehicle or a heavy goods vehicle driving license, the applicant for a license to drive a private motor vehicle should provide a medical report of fitness. The epileptic should be included in a general category of medically restricted drivers subject to individual medical assessment. In one series of 855 patients it was found that licenses had been issued to 204 out of 534 males (38%) and to 48 out of 321 females (15%).

Search terms: Epilepsy; Driver license standards; Driver license restrictions; Driver physical fitness; Great Britain; Male drivers; Female drivers; Problem drivers

3/12 Vision

HS-011 439 Fld. 3/12

SOME POPULAR MISCONCEPTIONS ABOUT VISION AND DRIVING

by Merrill J. Allen

Published in *Traffic Safety* v72 n2 p8-10, 32-3

Many people think sunglasses will cut glare, even at night, without realizing that sunglasses also reduce visibility. Tinted windshields may also reduce visibility. Horns are used to alert people to danger, but their sound does not carry as far as the light from flashing headlamps would carry. It may be that rapid flashing of headlamps should replace horn usage or be synchronized with it. Many people have been taught to watch the front wheels of an oncoming car to detect turning movement, but at high speeds this does not give sufficient warning. State driver license standards on central and peripheral acuity are criticized as insufficient. The accident rates of inexperienced young drivers and drivers over 45 are higher than average, and it is suggested that this is partly due to their driving old cars which are not in good condition. The problem of headlamp glare from oncoming cars is also discussed.

Search terms: Sunglasses; Reduced visibility; Tinted windshields; Horn usage; Headlamp usage; Headlamp daytime usage; Flashing lamps; Driver license standards; Driver experience; Young adult drivers; Aged drivers; Vehicle age; Headlamp glare; Turning; Oncoming vehicles; Visual acuity; Driving tasks; Central vision; Peripheral vision; Accident rates; Middle aged drivers

4/0 OTHER SAFETY-RELATED AREAS

4/5 Information Technology

HS-011 440 Fld. 4/5; 4/2

COMMITTEE ON COMPUTER TECHNOLOGY, AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS NATIONAL CONFERENCE PROCEEDINGS, ALBANY, NEW YORK, MAY 27, 28, 1970

American Assoc. of State Hwy. Officials

1971 411p refs

Includes HS-011 421 and 011 441

Proceedings of the former Committee on Electronics include papers on: a general traffic flow simulation model for freeway operation from the Connecticut Department of Transportation, Pennsylvania's materials and equipment inventory system; Wisconsin highway network data and information system; New York's planning information system; the road design, bridge design, and integration of design subsystem of TIES; Kentucky Department of Highways preconstruction project status; computer graphics and the ribbon of roadway; Montana's use of perspective plotting via electronic computer; computer graphics in the Bureau of Public Roads; and data plotting requirements of the Florida Department of Transportation. A list of registered guests is included.

Search terms: Computerized highway engineering techniques; Traffic models; Traffic simulation; Pennsylvania; Wisconsin; Total Integrated Engineering System; Kentucky; Florida; Computerized design; New York (State); Bureau of Public Roads; Connecticut; Inventories; Computerized records management; Information systems; State highway departments; State planning; Bridge design; Highway design; Montana

AVAILABILITY: NTIS as PB-204 511

HS-011 441 Fld. 4/5

HIGHWAY NETWORK DATA AND INFORMATION SYSTEM (HNDI)

by Gilbert Brumm

Wisconsin Dept. of Transp.

Published in HS-011 440, *Committee on Computer Technology, American Association of State Highway Officials National Conference Proceedings,* 1971 p106-45

Presented at the annual national conference of the American Assoc. of State Highway Officials' Committee on Computer Technology, Albany, 27-28 May 1970.

Wisconsin's Integrated Operations System is briefly described and the role of the Highway Network Data and Information System (HNDI) is explained. HNDI is to act as the central repository of technical information and provide for storage, processing, and output presentation of such information in support of the planning and accomplishment of improvement projects on Wisconsin roads. The HNDI data base is discussed, the stage 1 input and output processes explained and charted, and the general system data flow shown.

Search terms: Wisconsin; Information systems; Information system design; Flow charts; Computerized highway engineering techniques; Data processing

4/7 Mathematical Sciences

HS-011 442 Fld. 4/7; 5/22

MATHEMATICAL MODELS OF THE RIGID WHEEL ON SOFT SOIL

by Dieter Schuring

Cornell Aeronautical Lab., Inc.

1969 29p 19refs

Prepared for presentation at Third International Conference of the ISTVS, Essen, Germany, 10-14 Jul 1969.

Wheel performance on soft soil is determined by the stress distribution in the soil-wheel interface. Its mathematical representation is almost exclusively based on penetration and shear tests, which presumingly simulate the soil-wheel interaction. However, this "plate" approach fails to explain the real soil-deforming mechanism. The method of visioplasticity may lead to a better understanding of the wheel-soil interaction.

Search terms: Vehicle soil interface; Mathematical models; Wheel performance; Soil tests; Penetration tests; Shear stress

4/7 Mathematical Sciences (Cont'd.)

HS-011 443 Fld. 4/7

MATHEMATICAL ASPECTS OF A MULTI OBJECTIVE OPTIMIZING MODEL PROPOSED BY LEININGER ET AL.

by H. C. Joksch

Published in *Accident Analysis and Prevention* v3 n3 p209-13 (Oct 1971)

7refs

The mathematical aspects of a linear programming model to allocate resources to traffic safety measures are analyzed. Several objective functions are maximized, without requiring information on trade-offs between objectives.

Search terms: Mathematical models; Linear programming; Highway safety

4/8 Transportation Systems

HS-011 444 Fld. 4/8

NATIONAL TRANSPORTATION STATISTICS. SUMMARY REPORT

Department of Transp.

1971 88p refs

Summaries of selected national transportation statistics are provided. The summaries are of three types: tree displays, modal profiles, and transportation trends. The data base covers the years 1958 through 1970. Data summarization involves the selection of certain statistics from the data base and displaying them in such a fashion that comparisons of transportation measures and trends can be made easily. In general the data can be divided into three main categories: cost, inventory, and performance.

Search terms: Transportation statistics; Transportation studies; Transportation systems; Transportation system costs; Travel modes; Modal choice; Data acquisition; Travel by vehicle type; Vehicle mileage; Flow charts; Highway transportation; Rail transportation; Air transportation; Marine transportation; Pipelines; Economic analysis; Revenue; Freight transportation; Public transportation; Fatality rates; Speed studies

AVAILABILITY: Dept. of Transportation

5/0 VEHICLE SAFETY

5/2 Buses, School Buses, and Multipurpose Passenger Vehicles

HS-011 445 Fld. 5/2

DESIGN CONSIDERATION FOR MOUNTING A SCHOOL BUS BODY ON A TRUCK CHASSIS

by G. L. Hartman

Sheller-Globe Corp.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York, 1972, p15-9

Report no. SAE-720297

Chassis requirements for attaching a school bus body are described. The cooperative effort made by truck chassis and body manufacturers in recognizing problems and formulating objectives for their solution is discussed. Design objectives which have been formalized include dimensional references, changes made by the body manufacturers, and responsibilities of the chassis manufacturer. Design illustrations are presented. Body attachment is described. Remaining problem areas are discussed.

Search terms: Truck design; Chassis design; Body design; Design standards; School bus chassis; School bus bodies; School bus design

5/3 Cycles

HS-011 446 Fld. 5/3; 2/4

BICYCLE BOOM POSES NEW SAFETY DILEMMA

by Bob Crane

Published in *California Highway Patrolman* v34 n9 p4-5, 22-5 (Nov 1971)

The rise in bike-car accidents is a direct result of the gigantic increase in the number of bicycles being operated in California. Davis, Calif. is pointed to as one of the best examples of the use of bicycles and their coexistence with automobiles. During the first year of operation of special bike lanes, no accidents occurred in the special lanes. Many California cities are updating their transportation systems to include bikeways.

Search terms: Bicycle safety; Bikeway planning; Bicycle accidents; California

5/4 Design

HS-011 447 Fld. 5/4; 4/7

WATER PUMP POROUS BEARING DESIGN ANALYSIS

by L. L. Ting; D. W. Hall; J. E. Mayer, Jr.

Ford Motor Co.

1972 9p 18refs
Report no. SAE-720215

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

A method of analyzing the performance of a water-lubricated sleeve type porous bushing in an automotive water pump design is presented. Relations of bearing load capacity versus shaft speed are compared for sintered iron-graphite bushings, sintered iron or bronze bushings, and steel bushings. The load capacity is computed based on a minimum allowable film thickness during hydrodynamic operation, and on a maximum allowable temperature during boundary lubrication operation. Bench and vehicle tests show that sintered iron-graphite bushings are superior to sintered iron, bronze, or steel bushings, due to the lower coefficient of friction.

Search terms: Water pumps; Bearing materials; Journal bearings; Mathematical analysis; Eccentricity; Coefficient of friction; Mathematical analysis; Load bearing tests; Materials tests; Graphite; Iron; Steels; Bronzes

AVAILABILITY: SAE

HS-011 448 Fld. 5/4

A GENERAL DISCUSSION OF FLAMMABILITY AS RELATED TO THE AUTOMOTIVE INDUSTRY AND MVSS 302

by Charles D. Storrs; Otto H. Lindemann

Hooker Chemical Corp.

1972 5p 1ref
Report no. SAE-720263

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The Motor Vehicle Safety Standard 302 becomes effective September 1, 1972, establishing a 4 ipm horizontal burn rate for materials used in the passenger compartment of motor vehicles. Limitations of the standard are discussed. Conventional approaches to impart fire retardance to vinyls, polyolefins, urethane foams, ABS, polyester, and carpeting are reviewed. Potential problems associated with each of the approaches include fogging, dripping, staining, low-temperature flexibility, durability, effect on physical properties, and cost.

Search terms: Vehicle safety standards; Flammability tests; Fire resistant materials; Interior design; Test equipment; Materials tests

AVAILABILITY: SAE

HS-011 449 Fld. 5/4

DEUTZ CONVERTS AIRCOOLED DIESEL TO MULTIFUEL OPERATION BY ADDING HIGH-TENSION IGNITION SYSTEM

by Gerhard Finsterwalder

Published in *Automotive Engineering* v79 n12 p28-32 (Dec 1971)

Prepared for presentation at the Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The ignition system has a special spark plug located near the injector. Advantages of this arrangement are: free choice of ignition point within certain limits, ignition of the fuel directly after the beginning of injection, greater durability of the plug, and smooth combustion process over the entire load and speed ranges. This system enables the multifuel engine to operate on diesel fuel, premium gasoline, and any mixture of these.

Search terms: Engine conversion; Diesel engines; Ignition systems; Multifuel engines; Ignition timing; Electrodes

5/6 Fuel Systems

HS-011 450 Fld. 5/6

A MOBILE INSTRUMENTED VEHICLE FOR MEASURING ROAD PERFORMANCE AND EXHAUST EMISSIONS

by W. I. Doty; L. J. Olejnik

Shell Oil Co.

1972 10p 7refs
Report no. SAE-720212

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

Instrumentation in the vehicle includes exhaust-gas analyzers to measure unburned hydrocarbons, carbon monoxide, nitric oxide, and carbon dioxide concentrations in the exhaust gases. The center of the system is a 40-channel magnetic tape data logger which can accumulate approximately 1.5 million data points per hour. The data logging system includes 10 operating parameters, 10 exhaust gas temperatures, and 20 vehicle and engine temperatures. Accumulators are used to log time, distance, and fuel consumption. Manual data are also logged as an event reference. The data acquisition system allows an efficient manipulation of the data using high-speed computer facilities. Test results show typical applications of the vehicle in providing data on the effect of engine adjustment and component condition on performance, fuel economy, and exhaust emissions.

Search terms: Exhaust emissions measurement; Carbon dioxide; Carbon monoxide; Nitric oxide; Hydrocarbons; Chassis dynamometers; Steady state; Engine operating conditions; Fuel economy; Instrumented vehicles; Exhaust gases; Data acquisition; Road tests; Magnetic tapes; Computerized test methods; Engine performance

AVAILABILITY: SAE

HS-011 451 Fld. 5/6

CATALYTIC CONTROL OF NO$_x$ EMISSIONS FROM MOBILE SOURCES. FINAL REPORT

by Manfred I. Seegall; James C. Napier; William A. Compton

Solar

1971 158p 26refs
Contract EHS-70-114
Report no. EPA-EHS-70-114; PB-204 011; RDR-1700

5/6 Fuel Systems (Cont'd.)

HS-011 451 (Cont'd.)

The use of various catalytic media to control nitrogen oxide emissions from motor vehicle exhaust was investigated. Laboratory tests of various compounds were made. The compounds tested included rare earth oxides, platinum, palladium, copper dichromate, and modified monels. The modified monel compounds were found most effective in reducing nitrogen oxides. The ammonia formulation of all these catalysts was also measured and was frequently found significant. The study involved the design of experimental equipment for the gas reaction process and for the investigation of physical and chemical properties of the rare earth oxide catalysts. Also included were a theoretical nitric oxide equilibrium analysis, a reaction kinetics study, and a study in concentration of NO, CO, and CO_2 as a function of several reaction parameters of the catalytical gas reaction. The data were analyzed by the non-dispersive infrared analysis method for the gases and by titration for the ammonia.

Search terms: Catalysts; Nitrogen oxides; Exhaust emission control; Laboratory tests; Materials tests; Performance tests; Test equipment; Physical properties; Chemical properties; Nitric oxide; Reaction kinetics; Carbon dioxide; Carbon monoxide; Exhaust gases; Infrared analyzers; Titration; Gas analysis; Ammonia; Rare earths; Monel; Platinum; Palladium; Copper dichromate; Mathematical models

AVAILABILITY: NTIS as PB-204 011

HS-011 452 Fld. 5/6

A GUIDE FOR REDUCING AUTOMOTIVE AIR POLLUTION

Voorhees (Alan M.) and Associates, Inc.; Ryckman, Edgerley, Tomlinson and Associates

1971 81p 57refs
Contract CPA-70-100
Report no. PB-204 870

This guide is designed to aid transportation professionals and state air pollution control agencies in selecting controls pursuant to the Clean Air Act of 1970. It is established that air pollution from emissions is a serious problem requiring corrective action and that much improvement can be achieved through traffic operation and transportation planning. The means of reducing harmful exposure to air pollutants are: smoothing the flow of traffic; reducing concentrations of traffic, both geographically and by time of day; and reducing the total amount of travel. Techniques and their effectiveness are discussed, and the difficulties involved in implementing them are described.

Search terms: Air pollutant concentration standards; Air pollution control; Vehicle air pollution; Air pollution emission factors; Clean Air Act of 1970; Air quality standards; Transportation planning; Traffic management; Traffic flow; Time of day; Peak hour traffic; Traffic volume; Traffic signal networks; Travel patterns; Public transportation; Economic factors; Freeways; Arterial traffic volume; Central business districts; Highway improvements; One way traffic; Parking prohibitions; Transportation regulation; Transportation problems

AVAILABILITY: NTIS as PB-204 870

HS-011 453 Fld. 5/6

GOVERNMENTAL APPROACHES TO AUTOMOBILE AIR POLLUTION CONTROL

by Donald Infeld; Gregory Wilcox

Institute of Public Administration

1971 140p
Contract EHS-70-126
Report no. APTD-0766; PB-203 952

Governmental approaches to the control of private car air pollution are described. Three basic aspects are considered: average emission per vehicle per mile; miles of use; and location of use. Industry control of average emissions per mile is considered, including control technology, development of low emission vehicles and low pollution fuels, direct regulation, and economic incentives. Consumer control of average emissions per mile includes direct regulation, economic incentives, and state emission checking programs. Control of miles driven per year includes vehicle use restrictions, financial incentives, mass transit, and urban design factors. Factors relating to location of use are emission reduction through increasing average vehicle speed, traffic bans, and dispersion of urban areas. Emissions charge systems are also considered.

Search terms: Federal control; Air pollution emission factors; Vehicle air pollution; Vehicle mileage; Vehicle usage; Exhaust emission control devices; Economic factors; Exhaust emissions; Fuels; Driver mileage; Public transportation; Automobile bans; Urban planning; Automobile urban usage; Speed patterns; Traffic bans; Smog taxes; Propulsion systems; Low lead gasoline; Environmental planning; Air quality standards; Air pollution control costs

AVAILABILITY: NTIS as PB-203952

HS-011 454 Fld. 5/6

AUTOMOTIVE AIR POLLUTION

Anonymous

Published in *Pennsylvania's Health* v31 n1 p12-4 (Spring 1970)

Briefly describes the specific sources (tailpipe, crankcase, evaporating fuel) of automobile-generated air pollutants and some current controls (exhaust control and positive crankcase ventilation systems) which are standard on all 1968 and later automobiles. Presents Federal emission standards, figures for total amounts of annual pollution in Pennsylvania and specifically in Philadelphia and the Delaware Valley area, and some experimental exhaust control systems. Pennsylvanians spend twenty million dollars per year for automotive emission control devices.

Search terms: Pennsylvania; Carbon monoxide; Exhaust emissions; Hydrocarbons; Nitrogen oxides; Particulate air pollutants; Catalytic converters; Sulfur dioxide; Philadelphia; Smog; Crankcase emissions; Positive crankcase ventilation valves; Exhaust emission control devices; Exhaust emission standards; Evaporative emissions; Air pollution emission factors; Vehicle air pollution

5/9 Inspection

HS-011 455 Fld. 5/9

RENTAL CAR DIAGNOSTIC TECHNIQUES

by Robert F. Cahill

International Telephone and Telegraph Corp.

1972 8p 3refs
Report no. SAE-720234

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

An automobile inspection machine combining man and machine capabilities to match the defined goals and limitations of rental car inspection is described. Machine and driver combine to check 22 items including lights, tire pressure, tread depth, horn, brake function, radio, windshield wipers and washers, heater, gas tank, cleanliness, mirrors, air conditioner, seat belts, seat adjustment, turn signals, and spare tire.

Search terms: Diagnostic centers; Automated inspection equipment; Rented Automobiles; Vehicle inspection; Automobile tests; Automated inspection

AVAILABILITY: SAE

5/11 Maintenance and Repairs

HS-011 456 Fld. 5/11; 5/9

VEHICLE DIAGNOSIS AS AN INTEGRAL PART OF AN ADVANCED AUTOMOTIVE SERVICE SYSTEM

by E. Spengler

Volkswagenwerk A.G. (West Germany)

1972 11p 4refs
Report no. SAE-720235

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The newly-developed Volkswagen computerized diagnosis program is discribed, underlining its importance as an integral part of vehicle service within the framework of an automobile service system. Functional interdependence of product development and vehicle service is presented in schematic form. To realize an optimum automobile service system, expectations of customers, workshops, manufacturers, and legislators are taken into consideration. Methods and systems of condition inspection and locating of malfunctions on vehicles are outlined and evaluated from the technical and economic point of view.

Search terms: Volkswagens; Diagnostic centers; Vehicle inspection; Automobile maintenance; Computerized test methods; Automated inspection equipment; Electronic monitoring systems; Data processing

AVAILABILITY: SAE

5/14 Occupant Protection

HS-011 457 Fld. 5/14

BELTS SNAP BACK WITH AIR BAGS DELAYED: TRY THESE ON FOR SIZE

by William Flanagan

Published in *Automotive Engineering* v79 n12 p33-5 (Dec 1971)

Since the requirement for installation of passive restraints has been postponed, automobile manufacturers have the option of installing lap and shoulder belts with electrical interlocks and inertial reels. Several automobile safety experts think the inverted Y yoke offers greater protection. When installed with inertia reels, Y yoke harnesses provide greater safety and more convenience and comfort. NHTSA approval for the Y yoke is to be sought.

Search terms: Restraint system design; Shoulder harnesses; Inertia reels; Three point restraint systems

HS-001 458 Fld. 5/14

ALLIED CHEMICAL'S AIR CUSHIONS

Anonymous

Published in *Automotive Industries* v146 n4 p69-71 (15 Feb 1972)

One manufacturer's air bag design is described. The sensing system, inflation system, and bag porosity are discussed. The problem of legal liability in case of air bag failures and inadvertent firings is outlined.

Search terms: Air bag restraint systems; Air bag inflation devices; Legal factors; Manufacturers liability

5/14 Occupant Protection (Cont'd.)

HS-011 459 Fld. 5/14

BELTS THAT MAKE SENSE

Anonymous

Published in *Road Test* v8 n3 p42-3, 90 (Mar 1972)

A belt design called the Takata Electro Safety System (TESS) has been developed by a Japanese company. It is a lap and shoulder belt combination which can be fastened with one hand. A buzzer and flashing light warn if the belts are not fastened. The belts allow freedom of movement and comfort under normal conditions. The system includes a sensor which in case of a collision or other shock locks the passengers into a restrained and secure position, releasing them a few seconds later. The system is suggested as an alternative to the air bag.

> Search terms: Restraint system design; Shoulder harnesses; Seat belt design; Sensors; Audio warning devices; Flashing warning signals; Occupant protection; Three point restraint systems

5/18 Steering Control System

HS-011 460 Fld. 5/18

REPLACE BALL JOINTS FAST

Anonymous

Published in *Motor Age* v91 n1 p56-9 (Jan 1972)

Problems caused by worn or defective ball joints are given. Reasons for wear and the proper way to check for wear are detailed. Proper tools are held to be the key to doing the job efficiently and safely. Ball joint specifications with regard to axial and radial movement are tabulated for common models of domestic cars.

> Search terms: Ball joints; Repairing; Tools; Specifications; Inspection procedures; Automobile models

5/20 Trucks and Trailers

HS-011 461 Fld. 5/20

DESIGN CONSIDERATIONS FOR MOUNTING EQUIPMENT ON TRUCK CHASSIS

Society of Automotive Engineers, Inc.

1972 42p
Report no. SAE-SP-368

> Cosponsored by Society of Automotive Engineers and Truck Body and Equipment Association, Inc. Includes HS-011 445; 011 462 to 011 467

Seven papers are included dealing with design considerations for mounting various types of vehicle bodies on truck chassis: beverage body, service body, fire apparatus body, school bus body, truck mixer body, mobile home body.

> Search terms: Truck design; Chassis design; Body design; Body types

AVAILABILITY: SAE

HS-011 462 Fld. 5/20

DESIGN CONSIDERATION FOR MOUNTING A BEVERAGE BODY ON A TRUCK CHASSIS

by Julius P. Brauer

Hackney (J.A.) and Sons, Inc.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York 1972, p1-8

Report no. SAE-720294

Because the truck chassis manufacturer and the beverage body manufacturer do not work cooperatively, problems are encountered in mounting the body on the truck chassis, some because of the chassis design and some because of the chassis not being built according to recognized standards. Chassis requirements for a beverage body are reviewed, including dimensions; the cab; the truck frame; rear axle alignment; spring length and deflection; the transmission, driveline, and differential; brake assembly; brake boosters; air tanks; air brake lines; air or oil filters; fuel tank; battery; and electrical system. Recommendations in these areas are made for an ideal truck chassis.

> Search terms: Truck design; Chassis design; Body design; Chassis cabs; Frame design; Design standards

HS-011 463 Fld. 5/20

DESIGN CONSIDERATION FOR MOUNTING A SERVICE BODY ON A TRUCK CHASSIS

by H. W. Knapheide, 3rd.

Knapheide Mfg. Co.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York, 1972, p9-11

Report no. SAE-720295

The present lack of chassis uniformity among different makes of trucks forces the service body manufacturer either to produce a greater number of standard models or to modify standard service bodies to fit individual chassis. The problems created by the wide range of cab-to-rear axle lengths for a particular weight truck chassis, for example, could be eliminated by the use of one common length for each weight class. Other recommendations include: elimination of the drop frame chassis and the standardization of frame width and length for a particular weight class chassis. Fuel tank locations are also discussed.

> Search terms: Chassis design; Truck design; Body design; Vehicle length; Vehicle weight; Vehicle width; Fuel

tank location; Uniformity; Design standards; Standardization; Axles

HS-011 464 Fld. 5/20

DESIGN CONSIDERATION FOR MOUNTING A FIRE APPARATUS BODY ON A TRUCK CHASSIS

by Del Bilyeu

Truck Body and Equipment Assoc.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York 1972, p12-4

Report no. SAE-720296

The problems encountered in mounting fire pumps, fire truck bodies, and related equipment on a chassis are discussed. The problem area is defined and recommendations are offered for each of the following areas of the chassis: frame, electrical systems, fuel systems, brake systems, transmission and PTO systems, exhaust systems, drivelines, and lights. More technical cooperation between body and chassis manufacturers is suggested.

Search terms: Truck design; Chassis design; Body design; Frame design; Electric systems; Fuel systems; Brake systems; Transmissions; Power takeoff equipment; Exhaust systems; Drivelines; Vehicle lighting; Fire fighting; Pumps

HS-011 465 Fld. 5/20

THE PROBLEMS OF MOUNTING TRUCK-MIXERS ON TRUCK CHASSIS

by William H. Buelow; Earl C. Thayer

Rex Chainbelt, Inc.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York, 1972, p20-32

Report no. SAE-720298

Weight distribution considerations, operational considerations, and physical interference problems encountered in mounting concrete truck-mixers on truck chassis are discussed. Trends in mixer size growth and increased acceptance of hydrostatic drive systems are illustrated. A formula for arriving at a truck side-rail "beam" acceptability index is outlined.

Search terms: Transit mix trucks; Chassis design; Truck design; Body design; Vehicle size; Vehicle weight; Truck center of gravity; Drive systems; Nomographs

HS-011 466 Fld. 5/20

DESIGN CONSIDERATION FOR MOUNTING A MOBILE HOME BODY ON A TRUCK CHASSIS

by R. M. Premo

Sheller-Globe Corp.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York, 1972, p33-5

Report no. SAE-720299

Design factors are outlined for consideration by the suppliers of chassis for motor homes. Recommendations are presented for the frame, engine mounting, radiator, oil dip stick, automatic transmission, steering column angle and location, brake pedal, exhaust system, gasoline tank, ride quality, and front axle capacity. By working together cooperatively, the mobile home builder and chassis manufacturer can solve many of the problems described.

Search terms: Chassis design; Truck design; Body design; Frame design; Engine mounts; Radiators; Oils; Automatic transmissions; Steering columns; Brake pedals; Exhaust systems; Fuel tanks; Vehicle riding qualities; Front axles; Mobile homes

HS-011 467 Fld. 5/20

PROBLEMS CONFRONTING A TRUCK EQUIPMENT DISTRIBUTOR MOUNTING BODIES OR EQUIPMENT ON A CHASSIS

by J. Van R. Kelly

Watson Automotive Equipment Co.

Published in HS-011 461, *Design Considerations for Mounting Equipment on Truck Chassis* (SP-368), New York, 1972, p36-9

Report no. SAE-720300

Since most new trucks are built to the specifications of the customers, to transport specific commodities, cooperation is needed between the chassis manufacturer and the manufacturers of the rest of the trucks. Recommendations are made for the chassis frame, covering such areas as frame mounting surfaces, chassis frame length, frame strength at front end, and other aspects of frame design. Other problem areas discussed include cross member interference with PTO's, exhaust systems, clearances for controls, alternators and electrical systems, wiring recommendations, and clearances and locations of other equipment.

Search terms: Truck design; Chassis design; Body design; Frame design; Vehicle length; Power takeoff equipment; Exhaust systems; Control location; Electric systems; Control equipment; Alternators; Wiring

HS-011 468 Fld. 5/20

SOME DESIGN ASPECTS FOR HIGH-SPEED SNOWMOBILE SAFETY

by Edgar Rose

5/20 Trucks and Trailers (Cont'd.)

HS-011 468 (Cont'd.)

Outboard Marine Corp.

1972 9p 7refs
Report no. SAE-720257

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

Constructional features of the 140 mph snowmobile Pegasus are related to the various specifications considered essential to operator safety. Development of this vehicle involved investigation of crucial parameters such as yaw and drag on directional stability while operating at high speeds. These effects and other aerodynamic influences are explained as they affect single-track and dual-track vehicles. The final design incorporated measures to counter adverse tendencies during high-speed operation, as well as backup devices such as a rollover bar, auxiliary braking system, fire protection, and an escape mechanism.

Search terms: Snowmobile design; Safety devices; Yaw; Safety design; Suspension systems; Vehicle stability; Vehicle handling; Occupant protection; Aerodynamics

AVAILABILITY: SAE

NHTSA DOCUMENTS

NHTSA Contractors Reports

HS-800 526 Fld. 3/1; 4/2

PUBLIC INFORMATION AND PROGRAM FEASIBILITY STUDY FOR ALCOHOL COUNTERMEASURES (SUMMARY). FINAL REPORT

Martin Marietta Corp.

1971 31p
Contract FH-11-7588

Report for 1 Jul-31 Dec 1970.

A study on a program aimed at removing the problem drinker-driver from the nation's highways is summarized. Problem drinkers, roughly 7% of all drivers, were responsible for two thirds of all alcohol-related highway deaths in 1969. A summary of the alcohol countermeasures program is given; implementing agencies and public support are discussed; public acceptability, effectiveness, and feasibility of the program and various components are tabulated; and a list of possible individual countermeasures is given.

Search terms: Alcohol usage deterrents; Drinking drivers; Driver intoxication; Public information programs; Community support; Program evaluation; Benefit cost analysis; Alcohol education

AVAILABILITY: NTIS

HS-800 662 Fld. 4/7; 1/2

A NON-LINEAR DYNAMIC MODEL FOR PRIMATES

by Sanford B. Roberts; Robert B. Thompson

California Univ., Los Angeles

1972 115p 12refs
Contract FH-11-7482

A non-linear discrete parameter mathematical model describing the dynamic behavior of a primate (Macaca mulatta) has been developed and programmed for solution on the IBM model 360/91 computer using the Continuous Systems Modeling Program (CSMP). The primate is described by a system of discrete anatomical segments connected by translational and rotational springs representing the inter-segment stiffnesses. The predicted dynamic behavior of the rhesus monkey to blunt head impact compares favorably with the observations taken from high-speed films of a cerebral concussion experiment. A study of the effect of the point of application and angle of inclination of the forcing function was conducted. The results show that the important response parameters display the expected sensitivity to the location of the blow but are particularly sensitive to its angle of inclination with respect to the plane containing the foramen magnum.

Search terms: Dynamic models; Primates; Computerized simulation; Mathematical models; Head injuries; Brain concussion; Injury research; Animal experiments; Equations of motion; Center of gravity; Head impact tolerances; Nonlinear programming; Impact angle; Head impact areas; Animal impact tolerances; Stiffness

AVAILABILITY: NTIS

HS-800 664 Fld. 5/4

DEVELOPMENT OF A VEHICLE MOUNTED CRASH RECORDER

by C. L. Hudson

EG and G, Inc.

1972 67p
Contract DOT-HS-093-1-128
Report no. S-564-R

The DOT conceptual design guidelines called for a simple, self-contained recording accelerometer consisting of a spring/mass pendulum, a collimated radioactive light source as part of the inertial mass, and photographic film as the recording medium. The final design incorporated a pulsed light-emitting diode and optical lever instead of a radioactive light source. Laboratory and barrier crash tests of the prototype model show the system is capable of providing time-resolved acceleration data in any direction on a single plane. The prototype model has a range of 3 to 70 g, a natural frequency of 55 Hz, multi-accident capability, and high reliability.

Search terms: Accelerometers; Impact tests; Barrier collision tests; Recorders; Accident research; Sensors; Diodes;

Laboratory tests; Accuracy; Calibration

AVAILABILITY: NTIS

HS-800 666 Fld. 1/3

MULTIDISCIPLINARY ACCIDENT INVESTIGATIONS. FINAL REPORT

by D. A. Nagel; J. R. Manning; R. A. Gould; C. H. Chadwick; R. H. Cronin

Stanford Univ.

1972 378p
Contract FH-11-7583; DOT-HS-085-1-114

Analysis is presented of 36 selected traffic accidents investigated by the Stanford multidisciplinary team. Data from these cases are presented in summarized form to support the overall conclusions and recommendations developed during the course of the investigations. A description is also included of project operations, procedures, personnel, and organization. Appendices include case summaries, selected dynamics calculations developed during the investigations, and interview questionnaires. A new velocity-crush equation based on change of velocity is included.

Search terms: Accident investigation; Multidisciplinary teams; Accident case reports; Interviews; Questionnaires; Accident types; Accident factors; Accident causes; Accident reconstruction; Mathematical analysis; Vehicle dynamics; Restraint system effectiveness; Time of accidents; Crushing; Damage severity index; Restraint system usage; Acceleration; Impact forces; Age factor in accidents; Driver characteristics; Pedestrian characteristics; Injury factors; Injury severity index; Precrash phase; Environmental factors; Crash phase; Postcrash phase; Velocity; Head on collisions; Rear end collisions; Day of week

AVAILABILITY: NTIS

HS-800 667 Fld. 1/3

MULTIDISCIPLINARY ACCIDENT INVESTIGATIONS, PHASE 5. FINAL REPORT

by Paul H. Wright

Georgia Inst. of Tech.

1971 137p 13refs
Contract FH-11-7400

Rept. for Sep 1970-Sep 1971.

The results of a comprehensive and systematic study of thirty vehicular accidents, all but one of which occurred in the metropolitan Atlanta, area during the period April 1970-July 1971 are summarized. The research included an in-depth study of factors leading to the initiation of accidents as well as a study of the "second collision" to establish the kinematics of the occupants and to identify the agent(s) which caused the injuries and deaths. A summary of the findings from 100 collision investigations is included.

Search terms: Multidisciplinary teams; Accident investigation; Accident case reports; Injury severity; Repair costs; Accident causes; Restraint system usage; Damage severity; Atlanta; Accident factors; Precrash phase; Crash phase; Postcrash phase; Secondary collisions; Injury causes; Occupant kinematics; Fatality causes; Accident types; Environmental factors; Traffic control; Driver characteristics; Alcohol usage; Human factors; Vehicle inspection; Alcohol usage deterrents

AVAILABILITY: NTIS

HS-800 668 Fld. 5/14

EXPERIMENTAL EVALUATION OF THE DEPLOYMENT OF AN AIR BAG RESTRAINT USING HUMAN SUBJECTS (STATIONARY BODY BUCK). FINAL REPORT

by C. Russ Greer; C. Dee Gragg

Aerospace Medical Res. Lab.

1972 84p 10refs
Contract DOT-HS-017-1-017A

A test program was conducted to obtain data required for the evaluation of the effects of rapid deployment of an air bag system designed to protect the right hand and center passengers of a motor vehicle during a crash. Forty-one tests were conducted using human subjects seated in a stationary test apparatus referred to as a body buck. Seven body orientations were studied: right front seat passenger in a normal seated posture, center front seat passenger in a normal seated posture, right and center front seat passengers seated side by side in a normal seated posture, right front seat passenger with legs crossed, front seat passenger seated sideways, right front seat passenger with arms forward, and right front seat passenger leaning forward. Sixteen volunteers and two anthropometric dummies were used.

Search terms: Air bag restraint systems; Restraint system tests; Air bag inflation pressure; Human body segment parameters; Anthropometric dummies; Front seat passengers; Sitting (body position); Posture; Human body precrash position; Human body impact tolerances; Test volunteers

AVAILABILITY: NTIS

HS-800 670 Fld. 1/3

MULTIDISCIPLINARY ACCIDENT ANALYSIS. FINAL REPORT

by Fogarty; Freeman; Haviland

Miami Univ., Fla.

1972 330p
Contract DOT-HS-060-1-072

This summary report of the findings of 40 multidisciplinary vehicle accident analyses includes comments, recommendations, and conclusions regarding human, vehicle, and environmental

NHTSA Contractors Report (Cont'd.)

HS-800 670 (Cont'd.)

factors involved in vehicular collisions. Evaluation of federal motor vehicle safety standards and highway program safety standards, as they related to the in-depth analyses, is made.

Search terms: Accident analysis; Multidisciplinary teams; Precrash phase; Crash phase; Postcrash phase; Accident case reports; Accident causes; Human factors; Environmental factors; Fatalities; Collisions; Socioeconomic data; Alcohol usage; Driver experience; Driver criminal history; Restraint system usage; Injury severity; Ejection; Seat back failures; Vehicle age; Deformation analysis; Damage severity; Accident scale drawings; Driver characteristics; Accident types; Accident factors; Injury causes; Vehicle weight; Age factors; Vehicle characteristics; Highway characteristics; Vehicle safety standards; Highway safety standards

AVAILABILITY: NTIS

HS-800 673 Fld. 5/18; 5/20; 4/5

ARTICULATED VEHICLE HANDLING. SUMMARY FINAL REPORT

by R. L. Eshleman; S. D. Desai

IIT Res. Inst.

1972 27p
Contract DOT-HS-105-1-151
Report no. J6255-Sum

For abstract and search terms see HS-800 674.

AVAILABILITY: NTIS

HS-800 674 Fld. 5/18; 5/20; 4/5

ARTICULATED VEHICLE HANDLING. FINAL REPORT

by R. L. Eshleman; S. D. Desai

IIT Res. Inst.

1972 525p refs
Contract DOT-HS-105-1-151
Report no. J6255

An analytical and experimental investigation of articulated vehicle handling was conducted to develop the facility for prediction of the dynamic behavior of single and double articulated vehicles during commonly encountered road and speed maneuvers subject to aerodynamic influences. An experimentally validated digital simulation model, AVDS II, was developed which utilizes the inverse trajectory method whereby the steering demands, braking demands, and vehicle response are computed for given tire characteristics and prescribed tractor trajectory. The model was utilized to conduct a parameter variation study on the factors that affect articulated vehicle handling.

Search terms: Coefficient of friction; Vehicle handling; Vehicle dynamics; Simulation models; Computerized simulation; Vehicle trajectories; Parameters; Articulated vehicle modeling; Articulated vehicle performance; Tire characteristics; Steering; Braking; Aerodynamic configurations; Lane changing; Driving conditions; Speed; Tractor trailers; Mathematical analysis; Mathematical models; Multitrailers; Jackknifing; Yaw; Slip; Cornering; Antijackknifing devices; Antilocking devices

AVAILABILITY: NTIS

NHTSA Staff Speeches, Papers, etc.

HS-810 197 Fld. 5/14; 5/4

PASSIVE PROTECTION AT 50 MILES PER HOUR

by Robert L. Carter

National Hwy. Traf. Safety Administration

1972 47p 19refs

Presented to Second International Conference on Passive Restraints, 22-25 May 1972.

This paper examines the engineering and economic feasibility of inflatable restraint systems and structural modifications required to achieve passive protection for occupants in passenger car frontal collisions at 50 mph equivalent barrier speed. Vehicle structural modifications, already proven in prototype tests, are examined for compatibility in car-to-car crashes. The special aspects of inflatable restraint systems capable of 50 mph protection are also discussed, taking into account the improvements in system behavior made possible by structural modifications. Costs and benefits are also projected. It is concluded that cost effective 50 mph protection can be achieved.

Search terms: Passive restraint systems; Air bag restraint systems; Crashworthy bodies; Automobile design; Occupant protection; Barrier collision tests; Benefit cost analysis; Front end collisions; Automobile modification; Energy absorbing systems; Impact forces; Mathematical models; Impact tests; Vehicle vehicle impact tests; Side impact collisions; Restraint system design; Compact automobiles; Safety device costs

AVAILABILITY: NHTSA

HS-810-216 Fld. 5/0

STATEMENT BEFORE THE COMMITTEE ON COMMERCE OF THE UNITED STATES SENATE, NOVEMBER 21, 1967

by William Haddon, Jr.

National Hwy. Safety Bureau

1967 38p

The National Traffic and Motor Vehicle Safety Act of 1966 requires vehicle safety standards which are revised as the state of the art in vehicle safety performance improves. Recall campaigns and the benefits resulting from them are described. Tire safety and tire standards are discussed. Improvements in auto safety have already resulted in a slight decrease in traffic deaths. Lists are attached of suggested safety standard areas for which comments have been requested and of new and revised proposed standards. Statistics are included on recall campaigns and classification of safety related defects.

Search terms: National Traffic and Motor Vehicle Safety Act of 1966; Vehicle safety standards; Recall campaigns; Tire safety; Tire standards; Fatality rates; Safety design; Defective vehicles; Defects; Automobile safety characteristics

AVAILABILITY: NHTSA

HS-810 218 Fld. 2/0

STATEMENT BEFORE THE HOUSE APPROPRIATIONS SUBCOMMITTEE ON TRANSPORTATION, JUNE 5, 1967

by William Haddon, Jr.

National Hwy. Safety Bureau

1967 29p

The first nine months of activities of the National Highway Safety Bureau are described in relation to the Highway Safety Act and National Traffic and Motor Vehicle Safety Act. The development of motor vehicle safety standards, the recall campaigns for defective vehicles, tire standards, state and community safety programs, and the highway safety standards are described. Research activities and plans for the following year are outlined.

Search terms: National Highway Safety Bureau; Highway Safety Act of 1966; National Traffic and Motor Vehicle Safety Act of 1966; Vehicle safety standards; Recall campaigns; Defective vehicles; Tire standards; Tire safety; Highway safety programs; Highway safety standards; Appropriations

AVAILABILITY: NHTSA

HS-810 219 Fld. 2/0

STATEMENT BEFORE THE SENATE APPROPRIATIONS SUBCOMMITTEE ON TRANSPORTATION, JUNE 10, 1968

by William Haddon, Jr.

National Hwy. Safety Bureau

1968 19p

Programs, plans, and budget requirements of the National Highway Safety Bureau for fiscal 1969 are discussed. The development of safety standards is outlined. Statistics are included on recall campaigns, motorcycle fatality rates, funds for grants to state and community highway safety programs, and available federal grant funds.

Search terms: Appropriations; Highway safety programs; National Highway Safety Bureau; Safety standards; Recall campaigns; Defective vehicles; Motorcycle accidents; Motorcycle operator fatalities; Fatality rates; Grants; Federal aid

AVAILABILITY: NHTSA

HS-810 220 Fld. 2/0

STATEMENT BEFORE THE HOUSE APPROPRIATIONS SUBCOMMITTEE ON TRANSPORTATION, MAY 2, 1968

by William Haddon, Jr.

National Hwy. Safety Bureau

1968 15p

Programs, plans, and budget requirements of the National Highway Safety Bureau for fiscal 1969 are discussed. The development of safety standards is outlined. Statistics are included on recall campaigns, funds for grants to state and community highway safety programs, and available federal grant funds.

Search terms: Appropriations; Highway safety programs; National Highway Safety Bureau; Safety standards; Recall campaigns; Defective vehicles; Grants; Federal aid

AVAILABILITY: NHTSA

HS-810 221 Fld. 2/0

SAFETY—WHERE IT'S AT

by Douglas W. Toms

National Hwy. Safety Bureau

1970 18p

Presented to Automobile Importers of America, New York, 7 Apr 1970.

The highway safety problem is outlined. The crashworthiness of compact and subcompact imported cars is discussed. Federal efforts in highway safety are being directed toward priorities that can save most lives, especially getting problem drinkers off the highways and the development of air bag restraint systems. Other matters discussed briefly are the experimental safety car and design improvements to make autos more crashworthy.

Search terms: Highway safety programs; Crashworthiness; Crashworthy bodies; Compact automobiles; Priorities; Alcohol usage deterrents; Drinking drivers; Problem drivers; Air bag restraint systems; Occupant protection; Safety cars; Experimental vehicles; Safety design; Automobile design; Foreign automobiles;

AVAILABILITY: NHTSA

NHTSA Staff Speeches, Papers, etc. (Cont'd.)

HS-810 222 Fld. 3/1

REMARKS BEFORE THE 49TH ANNUAL CONFERENCE OF PILOT INTERNATIONAL, MIAMI BEACH, JULY 21, 1970

by Lawrence A. Pavlinski

National Hwy. Safety Bureau

1970 38p

Drinking drivers and their role in accidents are discussed. The relationship between blood alcohol levels and the establishment of fault in fatal accidents is described. There is considerable research to indicate that probably the majority of individuals responsible for fatal accidents involving alcohol are problem drinkers; they often have blood alcohol levels at or above 0.15%, arrest records involving alcohol, and are known to be alcoholics. The countermeasures needed are identification of problem drinker-drivers and programs to keep them from driving after drinking. Ten action areas for local programs are discussed.

Search terms: Alcohol usage deterrents; Drinking drivers; Driver intoxication; Accident responsibility; Blood alcohol levels; Accident causes; Problem drivers; Alcoholism; Driver criminal history; Driver identification; Community support; Alcohol education; Traffic law enforcement; Driver licensing; Traffic courts; Driver improvement schools; Program evaluation; Alcohol Safety Action Projects

AVAILABILITY: NHTSA

HS-810 223 Fld. 2/0; 3/1

STATEMENT BEFORE UNITED STATES SENATE, COMMITTEE ON PUBLIC WORKS, SUBCOMMITTEE ON ROADS, JULY 16, 1970

by Douglas W. Toms

National Hwy. Safety Bureau

1970 30p

The highway safety problem is discussed in terms of appropriations needed to deal with it effectively. Two top priority programs are alcohol countermeasures and passive restraints. The role played in accidents by the problem drinker-driver is described. The reorganization of the National Highway Safety Bureau is discussed and its plans and activities described.

Search terms: Highway safety programs; Appropriations; Priorities; Alcohol usage deterrents; Blood alcohol levels; Drinking drivers; Driver intoxication; Accident factors; Problem drivers; Alcohol education; Alcohol Safety Action Projects; National Highway Safety Bureau; Passive restraint systems; Highway safety organization management

AVAILABILITY: NHTSA

HS-810 224 Fld. 2/0; 4/1

STATEMENT BEFORE THE SUBCOMMITTEE ON PUBLIC ROADS, SENATE PUBLIC WORKS COMMITTEE, REGARDING FEDERAL HIGHWAY LEGISLATION, JULY 16, 1970

by John A. Volpe

Department of Transp.

1970 17p

Highway programs and the legislation needed for extending and strengthening them are discussed. Programs and projects described include the Interstate Highway System; public transportation planning; environmental planning; highway beautification; the TOPICS program; drinking driver control.

Search terms: Interstate Highway System; Highway planning; Federal laws; Public transportation; Environmental planning; Highway beautification; Traffic Operations Program to Increase Capacity and Safety; Drinking drivers; Alcohol usage deterrents; Highway safety programs; Transportation planning

AVAILABILITY: NHTSA

HS-810 225 Fld. 2/0

STATEMENT BEFORE THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, JULY 19, 1972

by Douglas W. Toms

National Hwy. Traf. Safety Administration

1972 8p

Testimony deals with proposals for amending the National Traffic and Motor Vehicle Safety Act of 1966, phasing in motor vehicle safety standards, and expanded use of the National Driver Register. Also discussed are safety efforts regarding crash survivability, active versus passive restraint systems, school bus safety, detection of defects.

Search terms: National Traffic and Motor Vehicle Safety Act of 1966; Vehicle safety standards; National Driver Register; Accident survivability; Crashworthiness; Restraint systems; Seat belts; School bus safety; Defective vehicles

AVAILABILITY: NHTSA

NHTSA Imprints

HS-820 187 Fld. 5/17

MOTOR VEHICLE SAFETY DEFECT RECALL CAMPAIGNS REPORTED TO THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION BY DOMES-

TIC AND FOREIGN VEHICLE MANUFACTURERS, JANUARY 1, 1972 TO MARCH 31, 1972

National Hwy. Traf. Safety Administration

1972 20p

This tabulation of safety defect recall campaigns includes the make and model, model year, description of the defect requiring manufacturer's corrective action, number of vehicles recalled, date of notification and identification number. Automobiles, trucks, school buses, trailers, and tractors are included.

Search terms: Recall campaigns; Defect correction; Statistics; Automobile recall campaigns; Truck recall campaigns; Trailer recall campaigns; Tractor recall campaigns; Defective vehicles

AVAILABILITY: GPO

SPECIAL ANNOUNCEMENT

We will be pleased to announce in HSL your research paper or research report not previously announced in this journal. The material must be directly related to Highway and/or Motor Vehicle Safety and must fall within the scope of the Table of Contents – Subject Fields and Groups.

Send your material, one (1) copy, along with your approval to announce, to:

Mr. Frank Skubel
Information Systems Division (43-33)
National Highway Traffic Safety Administration
400 7th Street, S.W., Room 5125
Washington, D.C. 20590

Please indicate the availability source and price if there is a charge for the item.

executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

APPLICATION OF RESTRAINT SYSTEMS TO USED CARS

The purpose for which this contract was awarded was to investigate the structural configurations of all major 1960 model year and later domestic and foreign built automobiles in service in the United States to determine the feasibility and cost of installing lap belt or lap and shoulder belt restraint systems. The basic objectives of the program were as follows:

- Determine the optimum installation methodology for maximum structural strength of seat belt and shoulder belt attachments.
- Develop methods and equipment for "proof-testing" seat belts to be installed.
- Develop an inspection methodology that would allow determination of structural integrity of installed seat belts and shoulder belts by installers and inspection stations.
- Design and develop seat belt and shoulder belt kits for foreign and domestic passenger vehicles of all make, models, and types.
- Perform structural proof tests and trial implementation studies of the completed kits to determine the usability and applicability factors.
- Conduct economic/feasibility studies to determine the minimum cost per kit installation and/or purchase.
- Develop final kit configurations, kit installation instructions, and parts catalogs for use by vehicle owners and commercial garages.

Contract No. FH-11-7306
Southwest Research Institute
Post Office Drawer 28510
8500 Culebra Road
San Antonio, Texas 78228

Award Amount: $69,539.00
Contract Period: June 20, 1969 thru July 20, 1970

DOT/HS 800 393 Final Report Volume I
DOT/HS 800 394 Exhibits and Drawings Volume II

General Comments

Surveys throughout the nation indicate a large percentage of the older vehicles are still without seat belts and only through constant education can the public be made aware of the safety aspects of the devices. It is hoped that the sample retrofitting seat belt kits described in the report will induce owners of used cars to have seat belts installed.

The development during this program of special rivnut type blind structural attachment is an important element in lowering the cost of seat belt installation.

The shoulder belt upper attachment has proven to be the more difficult installation due to the upholstery/trim problem and the small "closed" box section of roof structure over the door that prevents installation of normal attachments. Therefore, the rivnut has proven to be a very useful solution in this application also.

The discussions contained in the report along with the associated exhibits present the results of the sequential work efforts leading to development of the final kit configuration, parts list installation instructions, and the economic study.

MAJOR FINDINGS CONCLUSIONS AND RECOMMENDATIONS

The methodology for determining the various vehicle configurations via detailed inspections proved to be one of the most useful efforts in the program. The inspection procedure revealed the following points:

- Standard tunnel for drive shaft is common to most cars, foreign and domestic.
- Commonality of design by all manufacturers utilizing the side beam or torque boxes, frame construction, unibody construction and roof box structure.
- Commonality of design details between individual models of each manufacturer.
- Deterioration is minimal for vehicles up to 8-10 years old.
- Deterioration will not have a significant effect on installations utilizing the new kit design.
- Percentage of cars with front seat belts already installed is much higher than anticipated.
- Four percent of 1966 and older vehicles had rear seat belts installed.
- Less than one percent of 1966 and older vehicles had shoulder belts installed.
- Condition of belts in older vehicles was much better than expected.

All of these facts were ascertained during inspection of vehicle "on-the-street" and on used car lots. The original intent was to identify the vehicle's potential source of weaknesses and the possible need for structural reinforcement at the critical attach points. However, the combination of the seat belt proof-load pull test data and the inspection data details based on numerous models and makes indicate that attach points are available for which no reinforcement is required.

A large segment of vehicle sample population was included within the inspection program which covered almost one each of every model vehicle from every domestic manufacturer and some foreign manufacturers. The inspection teams were first trained in what to look for and why before being sent to perform the work. The first results were disappointing, so the teams were returned to the Institute and put to work on the pull test fixture wherein they inspected the vehicles, installed belts, and then pull tested each installation. With this knowledge they were able to accomplish the inspection and retrieve meaningful data. As noted in the above results, a great degree of commonality exists between designs, models and makes of cars that renders a standard kit design more widely applicable than originally anticipated. The commonality is usable in the economic evaluation of the kit fabrication and installation costs.

Based on the data generated by the seat belt program for used vehicles (1960-1969) the following conclusions can be made:

- Proof-test loads for installed seat belts are not recommended for used vehicles because of the large degree of vehicle deformation which results from loads in excess of 1,000 lbs per lap belt.
- If vehicle has lap belts installed with large area washers as anchors and the deterioration is less than 10%, the restraint system will probably withstand the required maximum load test.
- Deterioration in the floor pan structure where seat belts are usually attached is one of the most critical structural problems. Deterioration in the floor pan structure is more predominant in 1965 and older vehicles and occurs more frequently in coastal regions than elsewhere.
- Shoulder belts were originally a costly installation if no factory provisions for such were installed; also, some roofline existing structural attachments are marginal in strength, especially those of the single bolt type. A rivnut attachment in the roofline area requires less installation labor than does the conventional nut and bolt type of anchor.
- The combination lap and shoulder belt offers the best overall configuration for maximum safety with a minimum of confusion by excessive belt buckles lying on the front seat. This belt configuration encourages the use of the shoulder belt.
- Some of the shoulder belt kits available on the market today have roofline structural attachments which are marginal in strength.

- Many existing front seat lap belt floor attachments are improperly located. With the seat in the most rearward position, the attachments sometimes are under the seat, thus causing the belt to loop aft, up and forward. The 10,000 lb system test load applied simultaneously on the two front seat lap belts often caused failure of the seat track lock when the attachment points were located too far forward.

- The rivnut type blind attachment usually affords a faster and easier installation of both the lap belts and the shoulder belts. The greatest labor reduction was the virtual elimination of the upholstery/trim work in the shoulder belt installation. Also, the rivnut anchors eliminated the necessity for working beneath the vehicle as was necessary for the installation of the large area washer.

- Inspection procedures can replace the proof load test for determination of structural adequacy or integrity.

- Older model vehicles (1960-1963) cannot be eliminated from the requirement because they comprise a large percentage of the total vehicles in operation. For economic reasons the older model vehicles will not be retired as rapidly as they have been in the past (except through accidents), thereby requiring that greater consideration be given to the 1966 and older models.

- Two occupant front seat/rear seat lap belt kits using rivnut attachments can be sold to vehicle owners for under $10.00.

- Due to the cost of rivnuts, large area washer type kits could be manufactured and sold cheaper than the rivnut type kits; however, the installation cost of such a kit would be higher due to the charge for use of a hydraulic lift, or some other means of raising the car. Such an increase in installation cost would be approximately offset by the price of the rivnuts; therefore, the cost of the rivnut kit and its installation would be approximately balanced by that of the large area washer kit and its installation. But the rivnut offers the vehicle owner maximum protection if he is a do-it-yourself type. It also requires minimal equipment for any garage, shop or agency to accomplish the installation.

The foregoing items summarize the facts resulting from the investigation, inspection, testing and implementation of the seat belts and attachments developed in accordance with this work effort. The initial investigative and testing efforts resulted in findings concerning proof testing that caused an agreed change in direction for a portion of the program; but, as the results indicate, a more flexible restraint system for used cars was devised.

The Contract Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: NTIS, order DOT/HS 800 393 (PB 198 316) and DOT/HS 800 394 (PB 198 340) in paper copy (PC) or microfiche (MF).

executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

POLYESTER AND BELTED TIRE ROAD TEST EVALUATIONS

VOLUMES I AND II

The purpose for which this contract was awarded was to accomplish a road test evaluation of Government selected polyester, belted, and control tires to determine their operational characteristics in terms of safety related parameters of speed, load, inflation and impact.

Contract No. FH-11-7435
Hodges Transportation, Inc.
Nevada Automotive Test Center
Post Office Box 234
Carson City, Nevada 89701

Award Amount: $118,808.00
Period of Contract Performance:
November 18, 1969,
through December 31, 1970

DOT/HS-800 398 Volume I Appendix I – IV
DOT/HS-800 399 Volume II Appendix V – VII

General Comments

The tires tested in the study were polyester bias, polyester bias belted rayon bias, rayon bias belted, radial rayon belted and nylon bias.

The diversity of scope required that the program be divided into three distinct phases for continuity and correlation, as follows:

- Phase I – To design and certify by pretrial test the effect of impact on a passenger vehicle tire subjected to a raised object simulating a specific road hazard. The height and the directional attitude of the impact object, and the vehicle speed had to be determined precisely so as to direct the force into the tire system without immediate destruction.
- Phase II – This series of six specially tailored road tests was designed to determine the performance characteristics of polyester, belted, and other selected tires when subjected to controlled inflations, loads and speed. The final two tests in this phase related to a determination of comparative performance between tire samples with a normal break-in schedule and tires without break-in.
- Phase III – This study integrated the results of the Phase I determinations in order to consider the interaction of road endurance and dynamic tire impact under controlled vehicle operation on selected passenger vehicle tires. The primary test tires of this phase were inspected by fluroscopic X-ray technique prior to test and periodically during the test to determine if a correlation could be established between known anomalies within the tire system, as well as the effect of impact on the tire system, and resultant failures.

Definitions

Failure - The term "failure" used throughout the report denotes an anomalistic circumstance developed within the tire system which is recognized by the tire manufacturer as a valid warranty claim for adjustment *provided* no evidence of misuse is found.

Safety Related Failure - The term "safety related failure" used in the report relates only to those tires wherein total air loss was experienced before the test vehicle could be brought to a stop.

Procedure

All test conditions within the scope of the study were predetermined to simulate driving conditions to which the motoring public could concievably be exposed, and to determine if and to what degree safety related failures exist in relation to different tire systems under these conditions.

All testing conducted in the study was accomplished at loads above those recommended by the Tire and Rim Association (T&RA) for the inflation pressures used. As specified in the T&RA manual, as well as by passenger vehicle manufacturers, tire pressures must be increased when vehicle sustained speeds are to be above 75 miles per hour. In this testing all pressures were adjusted cold and the recommended increase of four pounds was not utilized.

Phase I was a series of experiments to objectively evaluate various tire impact configurations, vehicle speeds, and angles of approach to satisfy test requirements. The trial and error method, under the scrutiny of a high speed camera led to the decision to use five 3-inch high by 3-inch wide by 24 inches long steel beams anchored to the pavement at alternating 45 degree left and right angles to the path of the test vehicle. This method provided single impacts to the outside and inside of the test tire rather than to both sides simultaneously. Optimum speed for the impact was found to be 50 miles per hour. At speeds of 55 miles per hour and above, a distinct possibility of rim cutting occurs at the inflation pressures of 20 pounds per square inch (psi) front and 24 psi rear as specified for test Phase III.

Phase II consisted of a series of tests, each one designed to offer comparative criteria among the subject tire constructions and materials with tire load and inflation as the variables while holding vehicle speed constant.

The first test in this series was an evaluation of the following constructions and materials of H78-14 or equivalent size tires:

2 groups	2-ply polyester bias
1 group	2-ply rayon bias
1 group	4-ply nylon bias
1 group	4-ply polyester bias
2 groups	2-ply polyester bias + 2 glass belts
2 groups	2-ply rayon bias + 2 rayon belts
1 group	2 radial-ply rayon + 2 steel belts

These various groups of tires were all tested with a front tire load of 1600 pounds per tire (106% T&RA at 24 psi) at a cold pressure of 20 psi, and a rear tire load of 1815 pounds per tire (120% T&RA at 28 psi) at a cold pressure of 24 psi, and all were tested at a speed of 85 $\left(^{+0}_{-5}\right)$ miles per hour.

Phase IIa consisted of test runs made on two groups of 2-ply polyester bias + 2 glass belted tires with inflation pressures of 20 psi cold front and 24 psi cold rear and loaded to 1600 pounds (106% T&RA at 24 psi) at all wheel positions. Based on the safety related failure frequency of this same tire in Phase II, the test was designed to give comparative behavior data at light loads.

Phase IIb was a controlled under-inflation test with all tires inflated to 18 psi cold and a load of 1400 pounds per wheel position. Results of the Phase II testing indicated the desirability of establishing a "lower limit" to the load-inflation pressure range. The parameters were selected to represent a condition readily found in many passenger vehicles when occupied by five passengers and a limited luggage load in the trunk. The four types of tires in this study were 2-ply polyester bias, 2-ply rayon bias, 4-ply polyester bias and 2-ply polyester bias + 2 glass belts.

Results of the Phase II and Phase IIb testing were wide enough apart to suggest the desirability of generating additional pertinent data to help bridge the gap between the two. The loads and inflation pressures used in Phases IIc, IId and IIe were designed to fulfill this requirement.

Phase IIc was conducted at the T&RA rated load of 1510 pounds at each wheel position, for the inflation pressure of 24 psi cold. Here again, the recommended increase of inflation pressure of 4 psi for over 75-miles-per-hour speed was not used. The load distribution for this phase was more in line with general driving public service. Two-ply polyester bias + 2 glass belts and 2-ply rayon bias + 2 rayon belts were used in this comparison.

1 group	2-ply polyester bias
1 group	4-ply polyester bias
2 groups	2-ply polyester bias + 2 glass belts
1 group	2-ply rayon bias + 2 rayon belts.

Phase IId was a comparison of the performance characteristics between identical tires with and without normal break-in procedures. Inflation pressure was 24 psi cold at all wheel positions with a T&RA rated load for this pressure of 1510 pounds per wheel on the front tires and an overload of 15% or 1735 pounds per wheel on the rear tires. The test tires consisted of two groups each of 2-ply polyester bias + 2 glass belts, and 2-ply rayon bias + 2 rayon belts.

Phase IIe, a performance comparison between identical tires with break-in mileage and without break-in mileage, was conducted at T&RA rated load, 1510 pounds at each wheel position, for the inflation pressure of 24 psi cold. Here again, the recommended increase of inflation pressure of 4 psi for over 75-miles-per-hour speed was not used. The load distribution for this phase was more in line with general driving public service. Two-ply polyester bias + 2 glass belts and 2-ply rayon bias + 2 rayon belts were used in this comparison.

Phase III was conducted to compare bias versus bias belted construction behavior when the tire system was subjected to dynamic road impacts under an overload condition. The test was run at 85 miles per hour in 4000-mile increments with each increment having a final state of impact exposure. The impact state required that the test tires pass over five preset hazards at a speed of 50 miles per hour. Prior to test and after each 4000-mile increment, the tires were inspected by fluroscopic X-ray and force variation methods to record any effect of the impacts on the tire carcass or belt plies.

MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The various charts indicate that safety related failures experienced in this sequence of testing were all generated on rear tires at loads of 1650 pounds, or more, per tire and were not limited to a particular construction or material.

A "Group Withdrawal Chart" summarizes the performance of all tires tested showing group withdrawal and individual tire history plotted against miles.

The nondestructive investigation pointed out anomalies in several of the test tires prior to road test; however, no failure in that phase can be attributed to any of the defects located by fluroscopic X-ray.

The tires inspected by X-ray examination were subjected to impacts with the result that only one failure occurred in the five groups after impact. This failure was identical to a failure experienced in the road test period prior to impact.

As a result of this study it appears to the contractor that the education of the general driving public relative to the tire systems of passenger cars is a basic requirement. Also, that load limitations as specified by the Tire and Rim Association are sound. The only safety related failures produced in the study were beyond these specifications. The speed at which these tests were conducted was a constant ($85\ [^{+0}_{-5}]$ miles per hour) and although the inflation pressures were varied safety related conditions developed only within the higher load test phases.

The study of tires with break-in versus tires without break-in resulted in safety related and nonsafety related failures in each mode.

Conclusions

- No safety related failure occurred except at load and inflation levels outside the values recommended by both tire and vehicle manufacturers.
- The nondestructive inspection did not predict any mode of tire failure experienced. The failures recorded in this test phase were located where no anomalies were detected.
- No safety related distinction can be drawn between various tire fabric materials, used in the plies or belts.
- No safety related distinction can be drawn between various constructions.
- No safety related failure developed on the front axle.

Recommendations

- Indications of excessive heat are present in all modes of the safety related failures experienced in this test series. An indepth study of dynamic tire temperatures developed in the high load range could supply valuable data pertaining to the thermal mechanics of tire failure. An article entitled "New Approach to Tire Durability Testing" was published in the Rubber Chemistry and Technology Journal, Volume 38, Number 4, in November, 1965. This paper points out that correlation of tire durability to running temperature has been developed. Recognition of the thermal threshold of a given tire material and/or construction would be invaluable.
- Results of this test series suggest that the pursuit of safety related objectives be done in a load range from 1650 pounds per wheel or above for the speeds and tire sizes involved, since no safety related failure occurred below the 1650 pounds range.
- A study in the critical load range at reduced vehicle velocities could produce valuable comparative data to strengthen the load-speed safety relation aspect. The point must be made to the driving public that a relationship does exist between load and speed and the development of hazardous conditions that can affect stable operation of passenger vehicles. NOTE: T&RA recommendation of 4 psi increase for over 75 miles per hour sustained operation.

- Study inflation dependency of safety related failures within the critical load range with variable speeds. Inflation pressures are the sole responsibility of the vehicle operator whereas load carrying limitations are generally design oriented.

- Tests based on different rim widths for the same size tire may supply information on safety related situations produced by load-speed-inflation variations.

- Wheel well design, particularly on the rear of passenger vehicles, could be approached with the logic that the better the ventilation the better heat transfer characteristics. One of the important design criteria of any passenger vehicle tire is that of heat dissipation and in turn the environmental circumstances within which the tire operates controls to a great extent the efficiency of that design.

- A study of the effect of various passenger vehicle suspension systems and their effects on wheel loading may show a definite relationship to safety related conditions.

- Degradation of the vehicular suspension system can create an abnormal stress within the tire system as well as produce handling problems. Here again, the vehicle operator is the dependent factor in reading and reacting to these characteristics.

- A further study of dynamic impact effects could be made within the parameters of speed, load and inflation known to produce failures. Utilization of proven nondestructive inspection devices could give significant perspective to this testing.

- A study of different sizes of passenger vehicle tires could be made in the critical load range to determine if there is correlation among tire sizes with respect to safety related tire failures.

- It is recommended that statistically valid samples of polyester bias belted and rayon bias belted tires be exposed to the rear axle position conditions of Phase II in order to determine the significance of relative periodicity of safety related failures.

- Further testing may produce significant data from which a standard break-in procedure for tire and vehicle manufacturers could be derived, as well as for general driving public enlightment. The study of broken-in versus nonbroken-in tires was inconclusive in this contract due to limited tire samples and limited test environments.

The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

AVAILABILITY: NTIS, Springfield, Virginia 22151. Order by DOT/HS-800 398, DOT/HS-800 399 in paper copy (PC) or on michrofiche (MF).

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